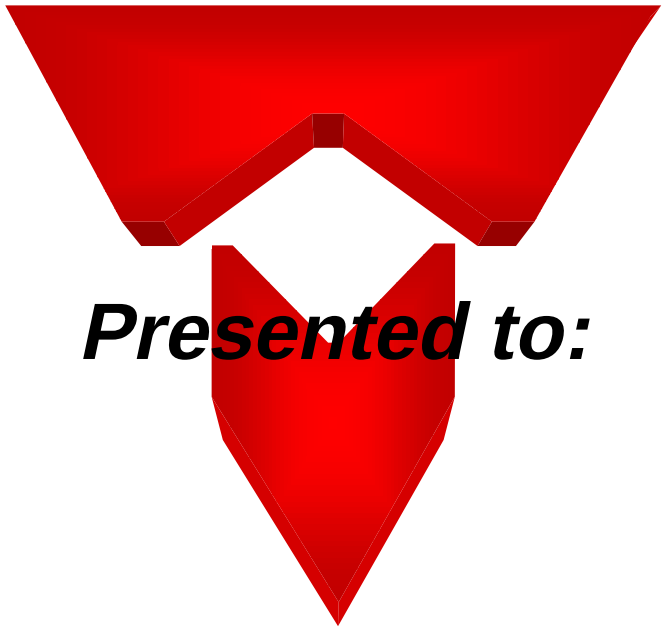
LONG RANGE ACCURACY
0.50 CAL AMMUNITION



Presented to:

1999 International Infantry & Small Arms
Section X - Symposium

June 23, 1999

Prepared by:

SNC INDUSTRIAL TECHNOLOGIES
MONTRÉAL, CANADA

and

SNC TECHNOLOGIES CORPORATION
AVON, CONNECTICUT

Authors:
Mrs Josée Fournier, R&D Scientist
Mr. J-P. Drolet Ph.D, Corporate Director

THREATS AND TRENDS

- **Threats**
  - Conventional Military Confrontations (2 - Medium Regional Conflicts MRC)
  - Asymetrical threats
    - Drugs
    - Terrorism
    - Biochemical / Chemical Weapons
    - Global Environmental Degradation
- **Trends**
  - Peace Keeping Missions
  - Humanitarian Missions

There is a NEED

for
Specialty Ammunition

for
the above threats and trends

such as
LONG RANGE HIGH ACCURACY AMMUNITION

OBJECTIVES BASED ON USERS FEEDBACK

- **Objectives**
  - Heavy caliber projectiles (min. wind drift, and drop in velocity)
  - Acceptable recoil (20-25 Joules with muzzle breaks)
  - Low muzzle flash
  - Accuracy of 1 minute of angle (MOA) at 1000m (1093 yards) and beyond
  - Capability of high rate production (industrial scale)
  - Operational cartridges to defeat strategic targets
  - Training rounds with training capability and impact signature

OBJECTIVES BASED ON USERS FEEDBACK

- **Strategy**
  - To develop, industrialize 0.50 cal Match ammunition
    - Target-practice / spotter (TP-S)
    - Armour-piercing incendiary (API)

POTENTIAL TARGETS

- **Examples of targets to be defeated (see Fig. 1)**
  - Windows of armoured vehicles
  - Infra-red detectors
  - Sniper weapon systems with optical sights
  - Radar antenna to detect aircraft
  - Destruction of claymore mines
  - Bunkers
  - Ship, boats, aircraft used for drugs/terrorism
  - Etc.

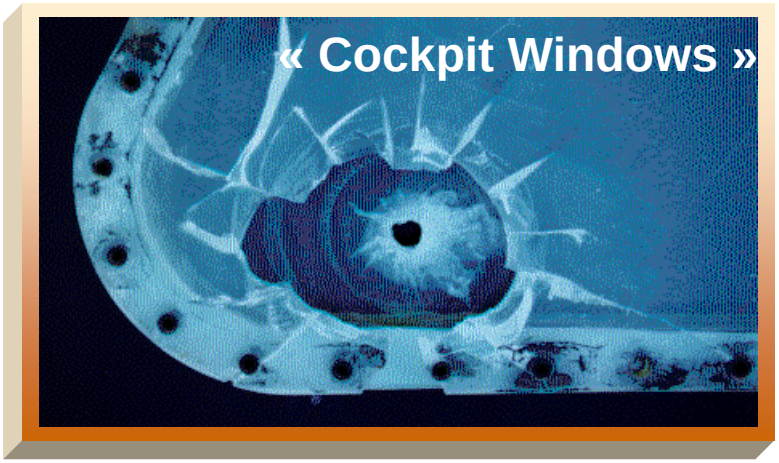


Figure 1 - Potential Strategic Targets

METHODOLOGY

- **Approach**
  - Optimization of:
    - projectile geometry
    - cartridge case geometry
    - assembled components

METHODOLOGY

- **First Design of Experiment (DOE)**
  - Design of experiment on 5 projectile characteristics
    - Length of the parallel section
    - Length of boat tail
    - Ogive geometry and length
    - Nose diameter
    - Intersection ogival # parallel section

Conclusion:

2 projectile geometries were retained for the last DOE

METHODOLOGY

- **Second DOE (factors affecting accuracy)**
  - Positioning of cartridges into gun chamber (sniper rifles on the market)
  - Tolerances between bullet jacket and projectile core
  - Concentricity
    - projectile body / pointed nose
    - projectile / cartridge case
  - Variation of propellant charges
  - Variation of priming charges
  - Cartridge case profile and geometry

<u>Conclusion</u>: 2 factors were retained for the final DOE:
- cartridge case and variation of propellant charge

METHODOLOGY

- **Third DOE**
  - Weapon platforms (2)
  - Projectile designs (2)
  - Propellant charges variations (0 grain, 4 grains)
  - Cartridge cases (standard 1995 and improved version)
- **Propellant**
  - Six propellants were tested: Spherical powder with low muzzle flash is preferred.
- **Primers**
  - Standard SNC primers

METHODOLOGY

- **Projectile Core Design**
  - Penetration
    - Impact angle 0°
    - Material: 2 hardened steels
    - Nose geometry: 30°, 60°, ogival shape
    - Armour plate: (22mm - 7/8 in.)
  - Spotter: (Ignition on target, not behind)

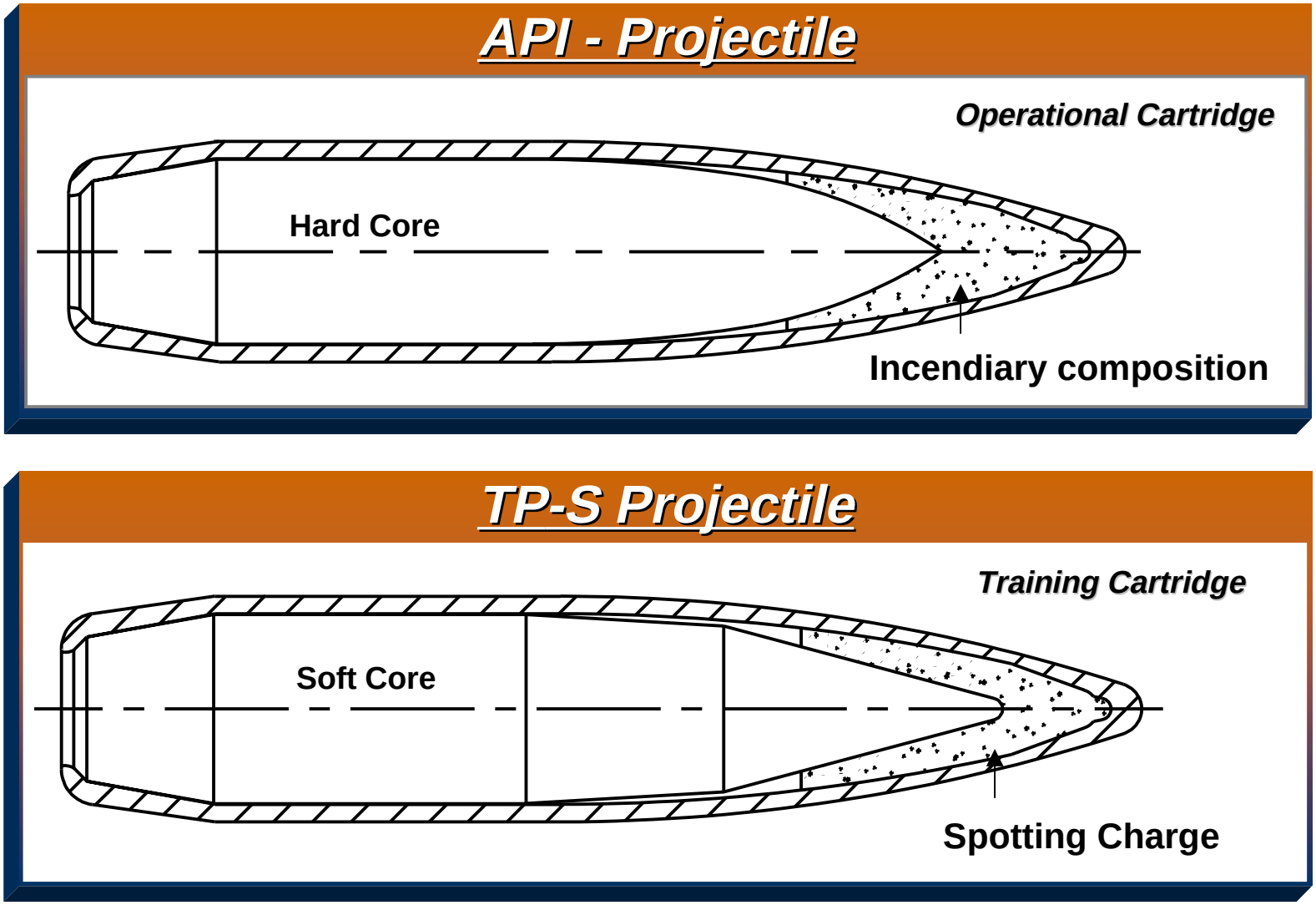


Figure 2 - API and TP-S Projectiles Configuration

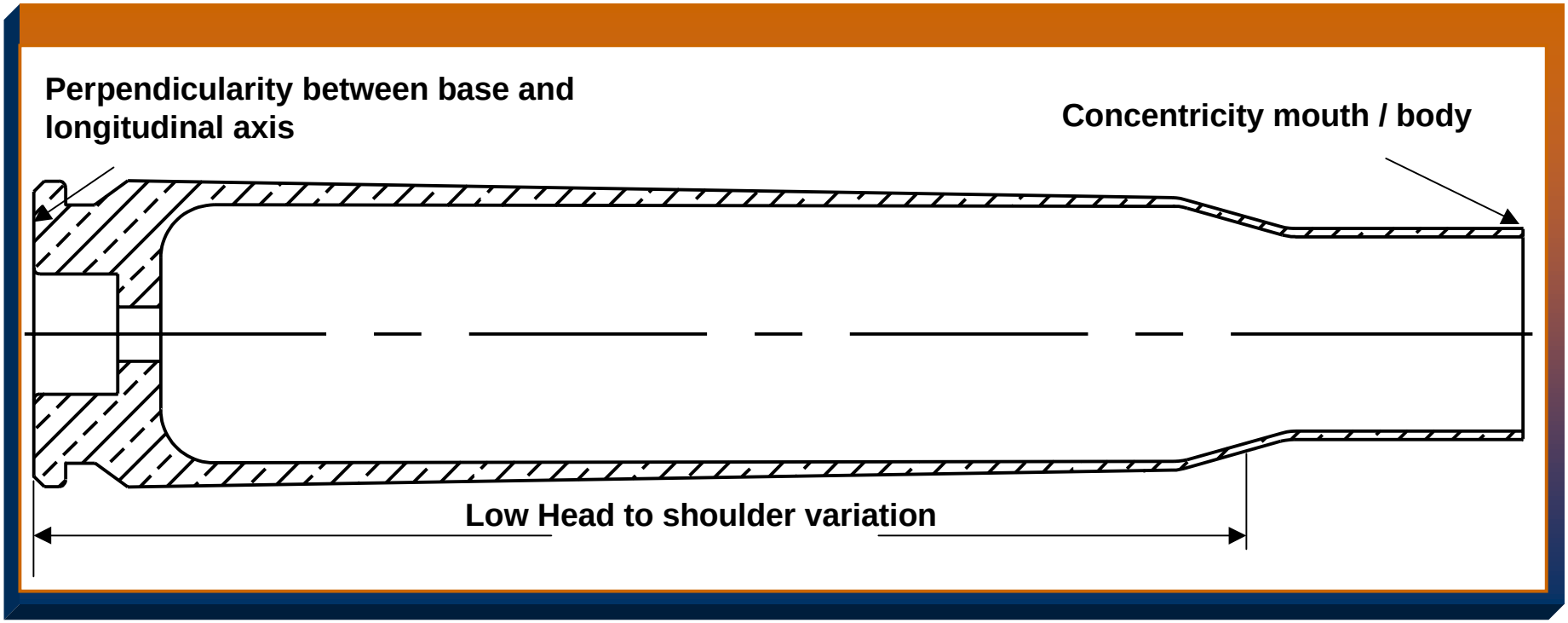
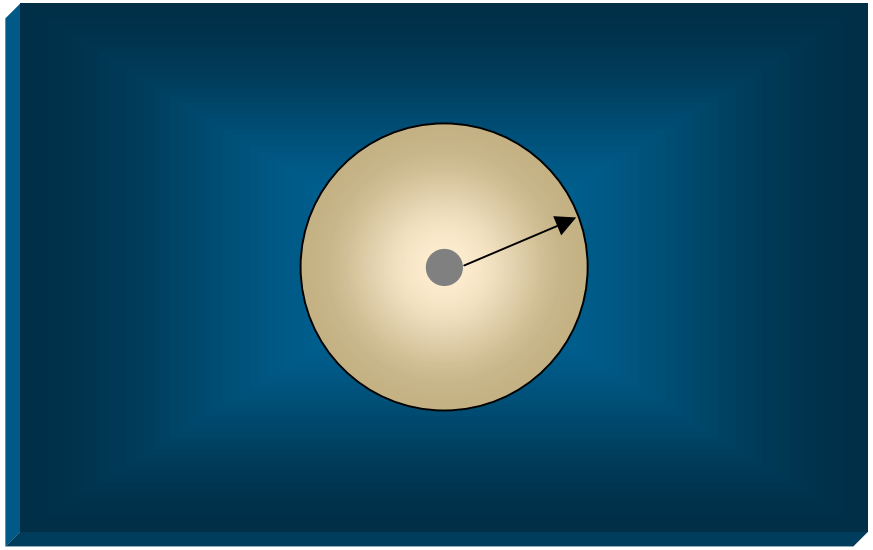


Figure 3 - Improved Cartridge Case for 0.50 cal Match Ammunition

PERFORMANCE CHARACTERISTICS

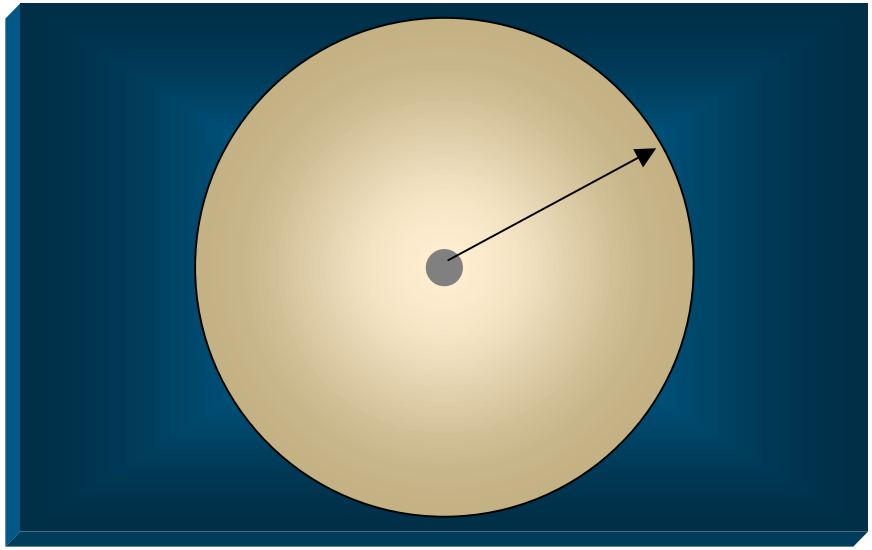
- **Dispersion**
  - Mean radius 19cm (7.5 in.) at 1,000m (1093 yards) or 0.65MOA
    (see figure 4)
    - 5 shots per target x 20 targets
- **Matching Trajectory**
  - Training Practice / Spotter (TP-S) and Armour-Piercing Incendiary (API) cartridges match perfectly.
- **Recoil Energy (with muzzle brakes) < 25 Joules**

Mean radius (0,65 MOA)
Short sniper barrels (29in)



0.50cal Match Cartridge

Mean radius (1,13 MOA)
Long M2 barrels



0.50 cal M33 Ball Cartridge

Figure 4 - Relative Accuracy
at 1,000m (1093 yards) between
0.50 cal Match and M33 ball cartridges

PERFORMANCE CHARACTERISTICS

- **Marking Effect** (see figure 5)
  - TP-S projectiles produce a visible flash upon impacting the target
    - Target: plywood 19mm (3/4in.) thick placed in front of a mild steel plate 0.64cm (1/4 in.) thick - no air space.
- **Incendiary Effects** (see figures 6 and 7)
  - Ignition upon impacting a 2mm (0.08 in.) thick) aluminium plate at 150m (163 yards). The flame is visible at a distance less than (60cm - 24in.) behind the plate.

PERFORMANCE CHARACTERISTICS

- **Penetration** (see figure 8)
  - 100% penetration of an armour plate 22mm (1/8 in.) thick, at 100m (328ft); 0° obliquity. (NATO standard, for reference only).

Figure 5 - Spotting effect at 1000m on a 4 x 4ft^2 panel)

Pyrotechnic composition

Pyrotechnic composition with HE

Figure 6 - Incendiary effects

Figure 7 - Incendiary effects

Figure 8 - Penetration test at 100m

(against NATO Target - reference only)

PERFORMANCE CHARACTERISTICS

- **Ballistic Characteristics**
  - In conformance with the NATO manual (MOPI-D/14) for:
    - Pressure
    - Velocity
    - Action time
    - Waterproofness
    - Functioning, etc…

- **Trace:**
  - None

PERFORMANCE CHARACTERISTICS

- **Safety**
  - Sensitivity of the incendiary/spotter charges during transportation and/or rough handling, are evaluated as follows:
  - ***Test 1:***
    - A load of 1.5kg (3.3lb) is dropped from a height of 1.5 meter (4.5ft) on the tip of the projectile.
  - ***Test 2:***
    - API projectiles are fired against a thin aluminium plate 1.27cm (0.5in) thick placed at 20m (72ft) from the muzzle of the gun.

CONCLUSION

- **SNC IT has developed unique 0.50 caliber high accuracy cartridges.**
- **These cartridges can be produced on an industrial scale.**
- **API and TP-S cartridges can now be made available.**

OTHER PRODUCTS IN THE ENGINEERING AND MANUFACTURING PHASE

- **0.50caliber limited range training ammunition (LRTA)**
- **5.56mm Improved penetration (IP)**
- **5.56mm “green” ammo, including non toxic primers and projectiles for training and operational uses**
- **5.56mm controlled penetration ammunition (CPA)**
- **5.56mm limited range training ammunition (LRTA)**